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Concordance and Conflict in Intuitions of Justice

Paul H. Robinson

Robert Kurzban

Note

NEPA and Scientific Uncertainty: Using the Precautionary Principle to Bridge the Gap

*Melanie E. Kleiss**

The Earth has spun around the intense energy of the sun for billions of years, experiencing eras of massive volcanic eruptions, violent earthquakes, and severe atmospheric conditions.[1] Life nonetheless began thriving on this planet two billion years ago,[2] but only during the last 500,000 years have *Homo sapiens* enjoyed an earthly dwelling.[3] Before the human population began to grow noticeably, the climatic, biologic, and geologic conditions of the Earth reached a mild and hospitable state for humans.[4] Today's natural systems provide moderate weather, generally stable geology, healthy biodiversity, and overall environmental conditions which allow human existence and persistence.[5] The Earth is hospitable for people and until recently has remained quite healthy for humans, despite human modification and degradation. Human activities in the last hundred years, however, have begun to erode this naturally healthful environment and render our surroundings toxic through pollution and destruction of the Earth's

* J.D. Candidate 2004, University of Minnesota Law School; M.S. in Science, Technology, and Environmental Policy Candidate 2004, Humphrey Institute of Public Affairs; B.A. 1998, University of Minnesota-Morris. For help and comments, I thank Jim Chen, Robert Kudrle, Jennifer L.M. Jacobs, Amy Salmela, and the staff and editors of the *Minnesota Law Review*. I am also grateful to my family for their continuous support and insight.

1. JONATHAN I. LUNINE, EARTH: EVOLUTION OF A HABITABLE WORLD 115 (1999) (describing the early state of the earth as "very hot and extremely active, with widespread volcanism").

2. NOEL T. BOAZ, ECO HOMO 13 (1997).

3. *Id.*

4. *Id.* at 20-21.

5. *See* SIMON A. LEVIN, FRAGILE DOMINION: COMPLEXITY AND THE COMMONS 7-8 (1999).

protective atmosphere.[6]

Congress recognized the vital link between human health and the environment and passed the unprecedented, far-reaching National Environmental Policy Act of 1970 (NEPA)[7] to protect the "natural environment."[8] NEPA requires a searching investigation before any federal action that may affect the environment goes forward. Such an investigation involves forecasting future impacts and predicting whether an activity will erode the necessary ecosystems that sustain our healthy human condition. Predicting environmental impacts always involves uncertainty, as Aldo Leopold recognized fifty years ago: "The ordinary citizen today assumes that science knows what makes the community clock tick; the scientist is equally sure that he does not. He knows that the biotic mechanism is so complex that its workings may never be fully understood."[9]

The mix of science and uncertainty baffles legal analysis. Courts interpret scientific uncertainty in the NEPA context inconsistently and often defer to agencies' incorrect interpretations of what constitutes uncertainty.[10] While commentators have discussed general approaches to dealing with scientific uncertainty,[11] their suggestions are often vague, qualitative, and never analyzed with particular attention to NEPA. Because NEPA strives for the laudable goal of human preservation and, due to its forecasting requirements, necessarily involves a vast amount of scientific uncertainty, employing clearly defined and proper methods of resolution is vital.[12]

This Note investigates the issues and ramifications of scientific uncertainty in NEPA litigation and suggests a method of resolution that stays true to the policy behind NEPA.

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6. BOAZ, *supra* note 2, at 240-67. "Surviving the environmental problems of our own making ... will be humankind's immediate challenge...." *Id.* at 267.

7. 42 U.S.C. § 4321-4370f (2000).

8. *Id.* § 4331(a).

9. ALDO LEOPOLD, A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE 205 (1949).

10. *See infra* notes 82-94 and accompanying text.

11. *See, e.g.*, Daniel Bodansky, *Scientific Uncertainty and the Precautionary Principle*, ENVIRONMENT, Sept., 1991, at 4, 4-5, 43 (discussing the adoption of the precautionary principle).

12. BOAZ, *supra* note 2, at 243 ("[W]e are not discussing altruistic 'save the earth' campaigns. We are discussing 'save the earth for us.'").

Part I describes the legislative history, text, and significance of NEPA and provides an introduction to the precautionary principle, a recently popular method of resolving scientific uncertainty. Part II illustrates how NEPA already embodies the precautionary principle and explains that resolution of scientific uncertainty can either undermine its precautionary nature or uphold it. This Note proposes that courts ensure that agencies correctly identify scientific evidence as "uncertain" and fully enforce the disclosure of uncertainty requirements of NEPA's implementing regulations.

This Note also suggests that courts should adopt procedures that more accurately translate scientific conclusions into legal conclusions. In particular, courts should lower the conventional scientific level of certainty from 95% to the predominant legal standard of preponderance of the evidence (51%) to ameliorate the intentionally anti-precautionary nature of the scientific standard and uphold NEPA's goals and policies. This Note concludes that the adoption of these proposals will not disturb past holdings that NEPA does not guarantee substantive results, but rather reinforces and upholds the policy of NEPA—to give proper pause before further degrading our precious human environment.

I. NEPA AND THE PRECAUTIONARY PRINCIPLE: HISTORY AND CURRENT DEVELOPMENTS

When passed in 1970, NEPA stood out as an unprecedented and forceful statute.[13] Unlike earlier environmental statutes, NEPA was not confined to a particular area of environmental regulation, but rather required comprehensive review and public discourse for any environmental impacts flowing from a federal action.[14] Furthermore, it was unusually concise[15] and has not endured repeated or comprehensive amendments like some other

13. LYNTON K. CALDWELL, THE NATIONAL ENVIRONMENTAL POLICY ACT: AN AGENDA FOR THE FUTURE 5 (1998); MATTHEW J. LINDSTROM & ZACHARY A. SMITH, THE NATIONAL ENVIRONMENTAL POLICY ACT: JUDICIAL MISCONSTRUCTION, LEGISLATIVE INDIFFERENCE, & EXECUTIVE NEGLECT 4 (2001).

14. LINDSTROM & SMITH, *supra* note 13, at 22.

15. *Compare* 42 U.S.C. §§ 4321-4370f (2000) (statutory text comprising approximately 16 pages), *with* 33 U.S.C. §§ 1251-1387 (2000) (statutory text comprising approximately 174 pages).

environmental statutes.[16] Numerous states have since passed legislation similar to NEPA.[17] Both NEPA and its implementing regulations contain implicit requirements for dealing with uncertainty in environmental impact analyses, but courts differ in their review of how agencies handle scientific uncertainty. The precautionary principle speaks directly to handling uncertainties and may offer guidance on how to uphold NEPA, our greatest statutory defense against overall environmental degradation.

A. THE PURPOSE AND LEGISLATIVE HISTORY OF NEPA

Congress passed NEPA in 1969 in response to a need to protect a healthy environment.[18] The DDT scare[19] and Rachel Carson's book, *Silent Spring*,[20] served as focusing events, directing nationwide attention to the consequences of environmental damage.[21] From 1967 to 1969 almost forty separate proposals relating to environmental policy and protection were introduced in Congress.[22] Although Congress passed other environmental statutes before NEPA, none had the broad scope and action-forcing[23] mechanisms that NEPA did, which were considered innovative and revolutionary at that time.[24] Senator Henry Jackson, for example, characterized

16. *See* Jaime Y. Tanabe, *The Commerce Clause Pendulum: Will Federal Environmental Law Survive in the Post-*SWANCC *Epoch of "New Federalism"?*, 31 ENVTL. L. 1051, 1058-59 (2001).

17. *See, e.g.*, Michael Dworkin et al., *The Environmental Duties of Public Utilities Commissions*, 18 PACE ENVTL. L. REV. 325, 330 (2001) (stating that as of 1995 nearly twenty states had "mini-NEPAs," their own versions of NEPA).

18. 42 U.S.C. § 4331(a) (recognizing "the critical importance of restoring and maintaining environmental quality to the overall welfare and development of [humans]").

19. DDT, or dichloro-diphenyl-trichloro-ethane, was widely used as an insecticide and later found to be toxic for many organisms, including humans. *See* Stephen H. Safe, *Endocrine Disrupters: New Toxic Menace?*, *in* EARTH REPORT 2000, 189, 191-93 (Ronald Bailey ed., 2000).

20. RACHEL CARSON, SILENT SPRING (Houghton Mifflin Co. 2002) (1962).

21. LINDSTROM & SMITH, *supra* note 13, at 19.

22. CALDWELL, *supra* note 13, at 28.

23. *See* Calvert Cliffs' Coordinating Comm., Inc. v. U.S. Atomic Energy Comm'n, 449 F.2d 1109, 1113 n.7 (D.C. Cir. 1971) (identifying NEPA's action-forcing procedures as those "which require full and rigorous consideration of environmental values as an integral part of agency decision making").

24. *See* ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 840 (3d ed. 2000) (describing NEPA as adopting an "unusual strategy" to achieve an "ambitious goal").

NEPA as "the most important and far-reaching environmental and conservation measure ever enacted."[25] The strong language of NEPA's policies and its legislative history indicate that Congress intended both procedural and substantive obligations to attach to agencies' actions.[26]

The stated purpose of NEPA remains to cultivate harmony between people and the environment, to encourage the prevention or elimination of damage to the environment and biosphere, and to enhance the understanding of ecological and natural resource systems.[27] Congress emphasized the "profound impact" of human activity on "all components" of the environment, particularly from population growth, urbanization, industry, resource use, and technological innovations.[28] As a result of these human activities, the dwindling assimilative capacity of the environment to absorb pollution and adapt to habitat destruction served as a major incentive for the rigorous analysis requirements of NEPA: "Today it is clear that we cannot continue to perpetuate the mistakes of the past. We no longer have the margins for error and mistake that we once enjoyed."[29]

To fulfill its stated purposes, some of NEPA's goals are "to create and maintain conditions under which man and nature can exist in productive harmony" and the continuing responsibility of the government "to use all practicable means . . . to improve and coordinate" government activities.[30] Congress further stated that coordination of the federal government's activities should enable each generation to serve as trustee of the environment for the next generation, ensure safe and healthy surroundings for all Americans, and achieve

25. 115 CONG. REC. 40,416 (1969); *see also* LINDSTROM & SMITH, *supra* note 13, at 5 (quoting Congressman Frank Pallone (D-N.J.), a member of the House Commerce Subcommittee on Health and Environment, as saying "the act is arguably the most important of all environmental legislation").

26. *See* LINDSTROM & SMITH, *supra* note 13, at 7 (highlighting statements of Congress that reflect the intent to prohibit actions that endanger the existence or health of humans or irreparably harm the air and land). *See generally* CALDWELL, *supra* note 13, at 36-38, 47 (describing the political climate and public and judicial response to NEPA and arguing that NEPA contains substantive mandates that have been consistently ignored).

27. 42 U.S.C. § 4321 (2000).

28. *Id.* § 4331(a).

29. *National Environmental Policy: Hearing Before the Senate Comm. on Interior & Insular Affairs*, 91st Cong. 205 (1969) (statement of Senator Henry M. Jackson).

30. 42 U.S.C. § 4331(a), (b).

wide beneficial use of the environment without "undesirable and unintended consequences."[31] Finally, Congress established the Council on Environmental Quality (CEQ) to enforce NEPA.[32] The CEQ implements regulations that have the force of law and has relative political autonomy to oversee agencies' compliance with NEPA.[33]

B. BASIC PROCEDURAL REQUIREMENTS OF NEPA

An agency must comply with NEPA when proposing major federal action that will significantly affect the quality of the human environment.[34] For such actions, NEPA requires preparation of an environmental impact statement (EIS) that discusses and analyzes the scientific evidence relating to potential or known environmental impacts of the action.[35] When preparing an EIS, an agency must discuss alternatives to the action, suggest mitigation measures if impacts are likely, and provide the opportunity for public participation.[36] The EIS must either conclude that the proposed action or alternative will not significantly affect the human environment, that feasible mitigation measures will lessen the impacts to a less-than-significant level, or that the benefits of the proposal outweigh the environmental costs, for the proposed action to go forward.[37] If the agency's findings, determinations, or failure to fully comply with NEPA procedures are legally challenged, a court reviews the agency's actions and conclusions under an arbitrary and capricious standard.[38]

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31. *Id.* § 4331(b)(1), (2), (3).

32. *Id.* §§ 4341-4345.

33. *See generally* LINDSTROM & SMITH, *supra* note 13, at 4, 43-44, 65-67 (describing the legislative history, purpose, and statutory authority of the CEQ).

34. 42 U.S.C. § 4332(2)(C).

35. *Id.* § 4332(2)(A), (C); 40 C.F.R. § 1502.2 (2002).

36. 42 U.S.C. § 4332(2)(C); 40 C.F.R. §§ 1502.16, 1503, 1506.6, 1508.9.

37. *See* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (holding that an agency has the discretion to find that social, economic, or other non-environmental benefits of a proposal outweigh the significant environmental effects); 40 C.F.R. §§ 1505.1-.3 (requiring that agencies implement procedures to achieve the requirements of 42 U.S.C. §§ 4331-4332 and implement mitigation established in the EIS).

38. 5 U.S.C. § 706(2)(A) (2000); Marsh v. Or. Natural Res. Council, 490 U.S. 360, 377 n.23 (1989) (overruling the lower court's application of a "reasonableness" standard in favor of the "arbitrary and capricious" standard).

C. THE SCIENTIFIC UNCERTAINTY OF ENVIRONMENTAL IMPACTS

Although scientists may be able to identify some potential environmental impacts of a proposed activity, future impacts are almost always uncertain.[39] For example, clearing part of a forest for development clearly reduces the number of trees and habitat for forest-dwelling organisms, but to what extent those organisms can adapt to both the loss of habitat and the increased human presence after completion of the development is largely unknown. The language of NEPA and its implementing regulations recognizes the possibility of scientific uncertainty regarding the environmental impacts of a proposed project.[40] One of NEPA's stated goals is to achieve a wide range of beneficial uses of the environment without, among other things, unintended consequences.[41]

NEPA implementing regulations previously required "worst case" analyses when essential information relevant to adverse impacts was unobtainable, but the CEQ has rescinded that requirement.[42] The "worst case analysis" requirement meant that where knowledge of impacts was lacking, the agency must assume the worst possible impacts before proceeding with overall analysis of the project.[43] Perhaps this requirement proved too cumbersome, since any scientific forecasting involves uncertainty at some point.[44] According to the Supreme Court, because the CEQ amended the regulations only after "considerable criticism" of the worst case analysis requirement, courts should give "substantial deference" to the new regulations.[45]

The amended CEQ regulation still requires full discussion

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39. Ethyl Corp. v. EPA, 541 F.2d 1, 24 (D.C. Cir. 1976) (en banc) ("Questions involving the environment are particularly prone to uncertainty."); Donald A. Brown & Patrick Zaepfel, *The Implications of Scientific Uncertainty for Environmental Law*, *in* SCIENTIFIC UNCERTAINTY AND ENVIRONMENTAL PROBLEM SOLVING 377, 379 (John Lemons ed., 1996); Bodansky, *supra* note 11, at 5.

40. *See infra* notes 41-51 and accompanying text. Neither NEPA nor its implementing regulations define the terms "uncertain" or "uncertainty."

41. 42 U.S.C. § 4331(b)(3); *see supra* note 31 and accompanying text.

42. 40 C.F.R. § 1502.22 (1985) (amended 1986).

43. *See, e.g.*, Friends of Endangered Species, Inc. v. Jantzen, 760 F.2d 976, 988 (9th Cir. 1985) (describing a worst cases analysis as "weighing the need for a proposed action against the worst possible consequences of such action").

44. *See supra* note 39 and accompanying text.

45. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 356 (1989). *See generally* PERCIVAL ET AL., *supra* note 24, at 903-05 (discussing the amended worst-case-analysis regulation and concurrent case history).

of the unobtainable information and a scientifically acceptable analytical approach.[46] More specifically, when an agency must deal with "incomplete or unavailable information" relevant to reasonably foreseeable significant adverse impacts, "the agency shall always make clear that such information is lacking."[47] If the information is unobtainable due to cost or unknown scientific methods, the agency must explain in the EIS how such information is relevant to evaluating reasonably foreseeable environmental impacts, the existing scientific evidence which is relevant to evaluating such impacts, and what impacts may occur based upon generally accepted theoretical approaches or research methods.[48] Agencies must also "insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements."[49] In an effectiveness study, the CEQ identified the lack of quality environmental data as a common malady in environmental review documents[50] and suggested that such a failure violates NEPA's mandate to "utilize a systematic, interdisciplinary approach."[51]

Scientists often define "scientific uncertainty" as less than 95% confidence that cause and effect have been established.[52] In contrast, legal findings of fact are often established when the "weight" of the evidence indicates a particular fact with 51% confidence or greater.[53] Therefore, when the "weight" of scientific evidence points to likely environmental consequences, nine times out of ten a scientist would still call such an indication "uncertain."[54] This anomaly is troubling because

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46. 40 C.F.R. § 1502.22 (2002).

47. *Id.*

48. *Id.* § 1502.22(b).

49. *Id.* § 1502.24.

50. COUNCIL ON ENVIRONMENTAL QUALITY, THE NATIONAL ENVIRONMENTAL POLICY ACT: A STUDY OF ITS EFFECTIVENESS AFTER TWENTY-FIVE YEARS 27 (1997).

51. *Id.* at 25 (citing 42 U.S.C. § 4332 (2)(A)).

52. Brown & Zaepfel, *supra* note 39, at 379; *see also* John Lemons et al., *The Precautionary Principle: Scientific Uncertainty and Type I and Type II Errors*, 2 FOUND. OF SCI. 207, 224, 227 (1997); Peter Montague, *The Uses of Scientific Uncertainty*, *at* http://www.psrast.org/precaut2.htm (last visited Jan. 16, 2003).

53. *See* Turpin v. Merrell Dow Pharm., Inc., 959 F.2d 1349, 1357 n.2 (6th Cir. 1992) (stating that the "weight of the evidence" standard requires the party bearing the burden of proof to prove its case to at least fifty-one percent of the evidence).

54. The calculation for this statement is based on the following: A judge

scientific uncertainty plagues environmental impact predictions for several reasons. First, the complex nature of the environment involves poorly understood and difficult to determine interactions.[55] Second, the impacts of interest to a decision maker are often those that are impossible to quantify, such as complete loss of a particular area.[56] Third, how and to what extent development will lead to more development is difficult to predict.[57] Finally, an EIS requires analyses of cumulative impacts, which are especially difficult and lead to persistent uncertainty.[58] Specifically, in the NEPA environmental review process, many aspects of both the data used and the decision made involve uncertainty.[59] Due to the reliance on scientific evidence in environmental litigation, the pervasiveness of uncertainty, and the differing standards for establishing causation in legal and scientific systems,[60] some commentators have urged the judiciary to adopt special rules and procedures for reviewing an agency's handling of scientific uncertainty.[61]

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would find a fact to be true if the weight of the evidence provided from 51% to 100% confidence, but a scientist asserts scientific certainty only when the confidence level is from 95% to 100%. Therefore, a scientist would label a conclusion uncertain while a judge would find the same conclusion true at the following rate: (95-51)/(100-51) = .90, or nine times out of ten.

55. Larry W. Canter, *Scientific Uncertainty and the Environmental Impact Assessment Process in the United States*, *in* SCIENTIFIC UNCERTAINTY AND ENVIRONMENTAL PROBLEM SOLVING 298, 312-13 (John Lemons ed., 1996).

56. *Id.*

57. *Id.*

58. *See* COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 50, at 28-29 (criticizing agencies for failing to analyze existing information effectively, resulting in less credible environmental review documents).

59. Canter, *supra* note 55, at 315-16; *see also* Lemons et al., *supra* note 52, at 209 (identifying sources of uncertainty as including lack of data, limitations of analytical tools, system complexity, and the need to make value judgments at all stages of the decision-making process).

60. *See supra* notes 52-53 and accompanying text (describing the difference between scientific certainty and judicial fact finding).

61. *See, e.g.*, DAVID VANDERZWAAG, CEPA AND THE PRECAUTIONARY PRINCIPLE/APPROACH 14 (1994) (urging the legal system to shift the burden of proof, thereby implementing a "polluter pays" strategy); JOEL TICKNER & CAROLYN RAFFENSPERGER, THE PRECAUTIONARY PRINCIPLE IN ACTION: A HANDBOOK 4, at http://www.biotech-info.net/handbook.pdf (last visited Jan. 16, 2003) (advocating that those proposing an activity should have to prove that the activity will not cause "undue harm" to the human or natural environment).

D. DEFINITION AND APPLICATION TECHNIQUES OF THE PRECAUTIONARY PRINCIPLE

The precautionary principle generally requires cautionary measures "even if some cause and effect relationships are not fully established scientifically."[62] Commentators have hotly debated, however, what qualify as cautionary measures.[63] This section summarizes the generally accepted characteristics of the precautionary principle, including the rejection of risk neutrality and precautionary decision-making procedures. The precautionary principle rejects risk neutrality, which calculates risk as simply a function of the magnitude and probability of harm, thereby ignoring most uncertainties.[64] For example, a risk-neutral person would spend $10,000 to avoid a ten percent risk of environmental harm valued at $1 million, because the risk (10%) multiplied by the harm ($1 million) equals $10,000.[65] In contrast, a precautionary person would likely spend more because some or most of the uncertainty in the risk calculation would be resolved to the advantage of the environment.[66]

While some commentators assert that the principle allows rejection of risk assessment altogether, Daniel Bodansky voices skepticism that intentional implementation of the precautionary principle would resolve the inherently difficult problems of regulating unknown environmental effects.[67] He repeatedly questions how levels of "acceptability" would be established: For example, how much evidence of potential environmental harm is necessary before invoking

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62. Joel Tickner & Carolyn Raffensperger, *The American View on the Precautionary Principle*, *in* REINTERPRETING THE PRECAUTIONARY PRINCIPLE 183, 192 (Tim O'Riordan et al. eds., 2001) (citing Nicholas Ashford et al., *Wingspread Statement on the Precautionary Principle* (Jan. 23-25, 1998), *at* http://www.greenpeace.org.au/toxics/pdf/wingspread.pdf); *see also* Lemons et al., *supra* note 52, at 210 (defining the precautionary approach as exercising prevention when "good reason" exists to expect environmental or health risks).

63. *See* VANDERZWAAG, *supra* note 61, at 14 (stating that the principle has been described, at one extreme, as entirely an administrative and legislative matter or, at the other extreme, as hinging completely on scientific proof).

64. Bodansky, *supra* note 11, at 5.

65. *Id.*

66. *Id.* (arguing that the precautionary principle ultimately forces a choice between risks); *see also* Carolyn Raffensperger, *Using Precaution in a U.S. Legal Context*, ENVTL. F., Sept./Oct. 1999, at 10 (asserting that the precautionary principle shifts the focus of regulation from "measuring and managing risk to finding solutions and preventing harm").

67. Bodansky, *supra* note 11, at 43.

precautionary approaches?[68] And, what kind of precautionary action is warranted and at what cost?[69] Unlike most commentators on the precautionary principle, Bodansky argues that the principle does not choose caution over risk, but rather chooses between two risks.[70] Bodansky's concerns address substantive issues of what decision to make, however, whereas implementation of precautionary procedures merely seeks to heighten decision makers' awareness and consideration of possible adverse impacts.

When applied to potentially harmful proposals, implementation of precautionary procedures operates differently at the decision-making and judicial review levels.[71] The decision-making level requires various steps to taking precaution: describing the environmental threat,[72] describing the scientific certainties and uncertainties,[73] identifying alternatives to the activity,[74] and determining a course of action based on all considerations and information in the previous steps.[75] In addition, some commentators assert that a necessary element of the precautionary principle is allowing the public—especially those who may be affected—to participate in decisions to better balance information in the face of scientific uncertainty.[76]

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68. *Id.* at 5.

69. *Id.* at 5, 43.

70. *Id.* at 43.

71. *Compare* Bodansky, *supra* note 11, at 5, 43 (discussing the two general legal techniques of dealing with uncertainty in a courtroom), *with* Raffensperger, *supra* note 66, at 10 (outlining the decision-making precautionary approach), *and* Montague, *supra* note 52, *at* http://www.psrast.org/precaut2.htm (identifying an approach similar to Raffensperger's, but with additional steps).

72. This step analyzes direct and indirect impacts, spatial and temporal extent of impacts, and the significance of impacts. Raffensperger, *supra* note 66, at 10; *see* Tickner & Raffensperger, *supra* note 62, at 204-05.

73. This step ascertains what is known, not yet known but knowable, and unknowable. Raffensperger, *supra* note 66, at 10; *see* Tickner & Raffensperger, *supra* note 62, at 204-05.

74. This step generates other options to achieve the same basic purpose of the proposed activity, thereby finding the least environmentally damaging alternative. Raffensperger, *supra* note 66, at 10; Tickner & Raffensperger, *supra* note 62, at 193, 205-06.

75. This step determines the level of precaution necessary and whether to avoid the activity, use an alternative, impose mitigation measures, or demand a performance bond. *See* Tickner & Raffensperger, *supra* note 62, at 208. Carolyn Raffensperger only implicitly suggests this step in her approach. Raffensperger, *supra* note 66, at 10.

76. *See* Tim O'Riordan et al., *The Evolution of the Precautionary Principle*,

On the other hand, when a court reviews a decision made in the face of scientific uncertainty, its options for dealing with such evidence (or lack thereof) include shifting the burden of proof[77] or filling gaps in knowledge with evidentiary presumptions.[78] If the burden of proof shifts to the party proposing the potentially harmful activity, that burden can be anything from an initial showing of unlikely harm to proof of safety or inertness.[79] The justification for shifting the burden of proof is that "those who have the power, control, and resources to act and prevent harm should bear that responsibility."[80]

E. JUDICIAL INTERPRETATION OF NEPA'S MANDATES WHEN SCIENTIFIC UNCERTAINTY IS INVOLVED

In the only federal case that mentions both NEPA and the precautionary principle, *Beanal v. Freeport-McMoran, Inc.*, the Fifth Circuit implied that NEPA contained policies like the precautionary principle.[81] The Second, Seventh, and Eighth Circuits implicitly invoke the principle by occasionally adopting mild precautionary approaches when discussing agencies' handling of scientific uncertainty in NEPA decisions, but usually give substantial deference to the treatment the agency

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in REINTERPRETING THE PRECAUTIONARY PRINCIPLE 9, 18-19 (Tim O'Riordan et al. eds., 2001); Tickner & Raffensperger, *supra* note 62, at 193, 206-07; Raffensperger, *supra* note 66, at 10 (arguing that the inherent politics behind determining causality in the face of uncertainty requires public involvement); Nicholas Ashford et al., *Wingspread Statement on the Precautionary Principle* (Jan. 23-25, 1998), *at* www.greenpeace.org.au/toxics/pdf/wingspread.pdf.

77. Bodansky, *supra* note 11, at 5 (stating that the burden of proof technique is appropriate only when enough information exists to define a range of possible environmental effects); O'Riordan et al., *supra* note 76, at 20; Raffensperger, *supra* note 66, at 10 (stating that the burden of proof can be shifted through assigning financial responsibility, requiring the posting of assurance bonds, or establishing a duty to monitor, inform, and act).

78. Bodansky, *supra* note 11, at 43 (stating that presumptions are often used when uncertainties are so severe that they cannot be quantified meaningfully).

79. *See id.* at 5. (describing the burden of proof as somewhere between showing plausible outcomes to proving harmlessness).

80. Raffensperger, *supra* note 66, at 10.

81. Beanal v. Freeport-McMoran, Inc., 197 F.3d 161, 167 (5th Cir. 1999) (stating that courts must exercise extreme caution when applying policies of NEPA and other U.S. domestic laws to claims under international law, in response to the argument that the court should apply the precautionary principle).

deems appropriate.[82] When granting deference, these courts often cite the Supreme Court's holding that "NEPA itself does not mandate particular results, but simply prescribes the necessary process."[83] This holding may be in conflict with CEQ regulations, which state that "NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action."[84] Often rejecting the deferential approach, the Ninth and D.C. Circuits tend to review agency decisions regarding scientific uncertainty with greater scrutiny, holding that agencies must take a "hard look" at environmental consequences.[85]

Perhaps demonstrating the greatest deference to an agency's interpretation of scientific uncertainty, the Seventh Circuit in *Sierra Club v. Marita* deferred to the Forest Service's determination that an entire field of science, conservation biology, does not produce reliable or applicable evidence.[86] Although the plaintiffs pointed out that "all scientific propositions are inherently unverifiable and at most falsifiable,"[87] the court nonetheless found that the Forest Service's acknowledgment and subsequent dismissal of conservation biological theories sufficed to qualify as taking a "hard look" at potential environmental impacts.[88]

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82. *See, e.g.*, Cellular Phone Taskforce v. FCC, 205 F.3d 82, 91 (2d Cir. 2000) (rejecting a precautionary review of agency guidelines because "[t]he argument that [an agency] should create greater safety margins in its guidelines to account for uncertain data is a policy question, not a legal one"); Sierra Club v. Marita, 46 F.3d 606, 623 (7th Cir. 1995) (deferring to the Forest Service's determination that an entire field of science, conservation biology, does not produce reliable or applicable evidence and is therefore "uncertain"); Lockhart v. Kenops, 927 F.2d 1028, 1034 (8th Cir. 1991) (holding that so long as scientific evidence exists to support the EIS analysis, conflicting evidence does not warrant judicial intervention).

83. *See, e.g.*, *Marita*, 46 F.3d at 623 (citing Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989), to support the holding that the agency need only discuss scientific uncertainties and is under no obligation to accept or reject them).

84. 40 C.F.R. § 1500.1(c) (2001); *see also* COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 50, at iv, 20, 29 (asserting repeatedly that the goal of NEPA is to reach a better decision, and not to simply produce documents).

85. *See, e.g.*, Nat'l Parks & Conservation Ass'n v. Babbitt, 241 F.3d 722, 733 (9th Cir. 2001); Midcoast Interstate Transmission, Inc. v. Fed. Energy Regulatory Comm'n, 198 F.3d 960, 967-68 (D.C. Cir. 2000).

86. *Marita*, 46 F.3d at 623.

87. *Id.* at 622 (arguing that allowing an agency to ignore theories of conservation biology because of "uncertainty" would, on the same logic, allow the agency to ignore the theory of gravity).

88. *Id.* at 623-24.

In contrast, the Ninth and D.C. Circuits occasionally show less deference to agencies by using the "hard look" doctrine[89] or CEQ regulations to support decisions to remand agencies' determinations in the face of scientific uncertainty.[90] As the Ninth Circuit held in one NEPA case, "[a]n agency must generally prepare an EIS if the environmental effects of a proposed agency action are highly uncertain."[91] In other words, the agency has the burden to show that a proposed action will not have a significant environmental impact; otherwise the agency must prepare an EIS.[92] If the agency prepares an EIS, it must fully discuss scientific uncertainty surrounding the proposed action.[93] Further, the EIS may not rest on stale or incomplete scientific evidence.[94]

The Ninth Circuit recently departed from its established precedent and held in *National Parks & Conservation Ass'n v. United States Department of Transportation* that if environmental damage is "purely speculative," the EIS need not discuss relevant uncertainties with specificity.[95] The court held that the EIS prepared by the Federal Aviation Administration (FAA) adequately discussed the potential impacts of alien species introduction from the expansion of an airport[96] because the plaintiffs failed to show specific, predictable environmental harm where evidence otherwise remained uncertain.[97] As the dissent noted, however, the FAA discussion of the threat of introduction was "virtually non-existent,"[98] even though the expansion would produce an

89. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (holding that NEPA requires agencies to take a "hard look" at the environmental impacts of a proposal).

90. *See, e.g.*, *Babbitt*, 241 F.3d at 730-33; Makua v. Rumsfeld, 163 F. Supp. 2d 1202, 1216-17 (D. Haw. 2001); Nat'l Audubon Soc'y v. Butler, 160 F. Supp. 2d 1180, 1188-89 (W.D. Wash. 2001).

91. *Babbitt*, 241 F.3d at 731.

92. *See id.*

93. *See* Seattle Audubon Soc'y v. Espy, 998 F.2d 699, 704 (9th Cir. 1993); 40 C.F.R. § 1502.22(b) (2002).

94. *See Seattle Audubon*, 998 F.2d at 704.

95. Nat'l Parks & Conservation Ass'n v. U.S. Dep't of Transp., 222 F.3d 677, 681-82 (9th Cir. 2000).

96. *See id.* at 682.

97. *See id.* at 680-81 (holding that the notorious unreliability of airport demand projections, "purely speculative" environmental damage, and the failure of the plaintiffs to identify a particular species that would be introduced constituted high uncertainty).

98. *Id.* at 687 (Fletcher, J., dissenting); *see also id.* at 683-84 (Fletcher, J.,

increase in yearly arrivals from Asia from 0 to 1100, and such flights increase the risk of introducing Asian species.[99] Despite the *National Parks* decision, the Ninth Circuit's requirements for compliance with NEPA often reflect precautionary approaches by generally shifting the burden of proof to the agency proposing the action and placing emphasis on scientific uncertainty and reliable evidence.[100]

When parties claim that an agency must delay its proposed action until more or better information can fill in gaps of scientific uncertainty, courts generally follow the D.C. Circuit's ruling in *Alaska v. Andrus*.[101] The D.C. Circuit held that NEPA requires agencies to obtain information concerning environmental consequences of their actions and that agencies cannot escape that duty by labeling the analysis of future environmental effects a "crystal ball inquiry."[102] Because NEPA's procedures are meant to ensure careful and informed decision making, an agency must comply with those duties "to the fullest extent"[103] and take a "hard look" at all potential environmental effects of a proposed project.[104] Important effects will thereby "not be overlooked or underestimated only to be discovered after resources have been committed or the die otherwise cast."[105]

Federal courts are inconsistent in their review of scientific uncertainty and agency treatment of uncertainty.[106] Most courts give substantial deference to an agency's handling of

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dissenting) (asserting that the agency failed to take the requisite "hard look" at the possible environmental impacts because it never analyzed the forecasts that predicted a likely impact).

99. *Id.* at 685 (Fletcher, J., dissenting).

100. *See supra* notes 91-94 and accompanying text.

101. 580 F.2d 465, 466 (D.C. Cir. 1978), *vacated in part on other grounds sub nom.* Western Oil & Gas Ass'n v. Alaska, 439 U.S. 933 (1978); *see also* DANIEL R. MANDELKER, NEPA LAW AND LITIGATION § 10:20 (2d ed. 2002) (discussing the holding in *Alaska v. Andrus*).

102. *Andrus*, 580 F.2d at 473; *see also* Save Our Ecosystems v. Clark, 747 F.2d 1240, 1249 (9th Cir. 1984) (holding that 40 C.F.R. § 1502.22 regulations clearly contemplates original research if necessary to effect a reasoned choice among alternatives).

103. Calvert Cliffs' Coordinating Comm., Inc. v. U.S. Atomic Energy Comm'n, 449 F.2d 1109, 1114-15 (D.C. Cir. 1971).

104. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (citing Kleppe v. Sierra Club, 427 U.S. 390, 410 n.21 (1976)).

105. *Id.* at 349.

106. *See supra* notes 82-94 and accompanying text (describing the different approaches of the Second, Seventh, Eighth, Ninth, and D.C. Circuit Courts of Appeals).

uncertainty, characterizing such review as "substantive" and therefore proscribed by Supreme Court jurisprudence.[107] The Ninth Circuit, on the other hand, often reviews agency decisions made in the face of scientific uncertainty with greater scrutiny than the other circuit courts, occasionally finding such decisions to violate the "hard look" doctrine or CEQ regulations.[108] Despite these trends, however, inconsistency predominates even within the circuit courts and exacerbates the difficulty of reconciling scientific evidence with the vital policies of NEPA.

II. PROPER NEPA ENFORCEMENT REQUIRES A PRECAUTIONARY APPROACH TO TREATMENT OF SCIENTIFIC UNCERTAINTY

By enacting NEPA, Congress required federal agencies to exercise caution, consider alternatives, and seek public comments before committing themselves to activities that may harm the environment.[109] In these respects, NEPA represents a statutory enforcement of the precautionary principle.[110] Because of the nature of environmental impact assessment and ecological prediction, scientific uncertainty plagues the environmental analyses required under NEPA.[111] To uphold the inherent precautionary nature of NEPA, agencies should meaningfully consider and disclose such uncertainties.[112] Likewise, courts should ensure that agencies do so, through fully enforcing NEPA's implementing regulations that require the disclosure of incomplete or unavailable information.[113] Further, courts should recognize and mitigate the inherent reluctance of scientists to find correlations between human activities and environmental impacts.[114] With these methods, courts will better serve congressional intent and inch ever

107. *See supra* notes 82-83 and accompanying text.

108. *See supra* notes 89-90 and accompanying text.

109. *See supra* Part I.A-B.

110. *See supra* Part I.A-B.

111. *See supra* notes 55-59 and accompanying text.

112. *See supra* note 73 and accompanying text.

113. 40 C.F.R. § 1502.22 (2002); *see also supra* notes 46-48 and accompanying text (discussing CEQ regulations for incomplete or unavailable information).

114. *See* Lemons et al., *supra* note 52, at 217-18 (asserting that the pervasive uncertainty inherent in complex environmental issues precludes finding cause and effect relationships, and that classical science thereby leads to conclusions of negligible impacts).

closer to the goal of harmonizing human activities with a healthy environment.

A. CONGRESS CREATED STATUTORY PRECAUTION THROUGH NEPA

As some commentators have noted without detailed explanation, NEPA's policies, goals, and requirements embody a precautionary approach to decisions that may affect the environment.[115] Although the precise definition of the precautionary principle escapes consensus,[116] the principle generally requires cautionary measures "even if some cause and effect relationships are not fully established scientifically."[117] This generally accepted definition especially resonates in NEPA's stated policy of preventing or eliminating environmental damage,[118] its recognition of humankind's profound and multi-faceted impact on the environment,[119] and its policy of avoiding unintended consequences.[120] When faced with scientific uncertainty regarding possible future impacts, any of these concepts counsel in favor of selecting a safer alternative or postponing the proposed project—in other words, taking precaution.[121] In addition, NEPA's far-reaching goals,

115. *See* Tickner & Raffensperger, *supra* note 62, at 187-88 (asserting that NEPA implicitly contains the precautionary principle through establishing goals for environmental protection, a right to a healthful environment, and a responsibility for agencies to comprehensively study impacts of and alternatives to proposed projects); *see also* CALDWELL, *supra* note 13, at 78 ("A major purpose of the Act was to integrate environmental values into Federal policies and programs . . . ."); Bodansky, *supra* note 11, at 5 ("Although environmentalists often assume that the precautionary principle is a new idea, it has been for many years the basis of much U.S. domestic environmental legislation.").

116. *See, e.g.*, Lemons et al., *supra* note 52, at 235 (stating that no precise agreement exists as to what the precautionary principle entails); *see also supra* Part I.D (discussing the definition and application of the precautionary principle).

117. Nicholas Ashford et al., *Wingspread Statement on the Precautionary Principle* (Jan. 23-25, 1998), *at* http://www.greenpeace.org.au/toxics/pdf/wingspread.pdf; *see also* Lemons et al., *supra* note 52, at 210 (defining the precautionary approach as exercising prevention when "good reason" exists to expect environmental or health risks).

118. 42 U.S.C. § 4321 (2000).

119. *Id.* § 4331(a).

120. *Id.* § 4331(b)(3); *see generally supra* notes 26-31 and accompanying text.

121. *See generally supra* notes 118-20 and accompanying text (demonstrating that cited purposes of NEPA ultimately prescribe environmental precautions).

comprehensive analysis requirements, emphasis on alternatives,[122] and public notice requirements strongly resemble the generally accepted approach to implementing precaution at the decision-making level: describe the environmental threat, describe the scientific certainties and uncertainties, identify alternatives, and allow public participation.[123]

NEPA's rigorous analytical requirements also seem to focus equally on what is known and what is not known, suggesting that scientific uncertainty should not receive neutral treatment or remain ignored. Specifically, NEPA and its implementing regulations require full discussion and disclosure of a proposed project's impacts,[124] the methods used to analyze the impacts,[125] and, most importantly, any incomplete or unavailable information relevant to reasonably foreseeable significant adverse impacts.[126] Indeed, during Senate deliberations on NEPA, Senator Jackson argued that agencies should err on the side of environmental protection when conflicts arise in the decision-making process,[127] and that we can no longer tolerate margins for error and mistake.[128] Such statements advocate precaution and imply that persistent scientific questions should not be ignored or treated neutrally, but rather should lead toward the assumption that negative impacts could occur. Finally, Supreme Court jurisprudence also appears to recognize the precautionary nature of NEPA's procedural mandates, emphasizing that NEPA protects against realizing harmful environmental impacts too late.[129]

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122. 42 U.S.C. § 4332(2)(E) (requiring an analysis of alternatives for every proposed action involving unresolved conflicts, regardless of whether the action will significantly impact the environment); *see, e.g.*, Davis v. Mineta, 302 F.3d 1104, 1122 (10th Cir. 2002) (holding that the two alternatives considered in the Environmental Assessment (EA) did not sufficiently analyze available alternatives for the proposed highway construction project).

123. *See supra* notes 72-76 and accompanying text.

124. 40 C.F.R. § 1502.1 (2002) (the EIS "shall provide full and fair discussion of significant environmental impacts").

125. *Id.* § 1502.24 (agencies must identify the methodologies used and make reference to sources relied upon).

126. *Id.* § 1502.22.

127. LINDSTROM & SMITH, *supra* note 13, at 78; *see also supra* notes 28-31 and accompanying text (describing the legislative history of NEPA that indicates an intent that environmental issues be resolved in favor of protection).

128. *See supra* note 29 and accompanying text.

129. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349

B. DEALING WITH UNCERTAINTY IS VITAL TO THE GOALS, POLICIES, AND EFFECTIVENESS OF NEPA

The strong precautionary elements of NEPA's legislative history and text suggest that Congress foresaw the necessity and importance of dealing with scientific uncertainty in the EA/EIS process.[130] Indeed, the failure to recognize, disclose, and discuss uncertainty undermines the processes essential to NEPA: public participation, identification and acceptance of better alternatives, and overall policies and goals.[131] Such avoidance and rejection of scientific uncertainty as a tool effectively "derail[s] preventive policy from being drafted."[132] If every impact were certain, the best alternative would be clear, and public participation would only serve to illuminate social, not environmental, issues. Furthermore, because uncertain environmental impacts both plague almost every environmental review document and serve as the key to upholding the purpose and goals of NEPA, courts and policy makers alike should pay greater attention to the inherent biases in scientific uncertainty. Not only does the scientific method operate to preclude precautionary measures, but administrative processes by their nature also tend to be anti-precautionary.[133] These potential blows to the important purposes of NEPA call for a searching investigation and understanding of why and how science undermines the precautionary nature of NEPA and an invocation of methods to counteract or mitigate such tendencies.

An inherently precautionary environmental statute like NEPA naturally leads to scarce, uncertain, or conflicting evidence because the statute pushes scientific knowledge to its current boundaries.[134] The drafters of NEPA recognized the limitations of classical science and therefore included a requirement to consider the social sciences as well.[135] While

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(1989); *see also supra* notes 103-05 and accompanying text (discussing NEPA procedures).

130. *See supra* Part II.A.

131. *See supra* notes 71-76 and accompanying text (describing these processes as precautionary procedures intended to cope with uncertainty).

132. LINDSTROM & SMITH, *supra* note 13, at 55.

133. *See* Lemons et al., *supra* note 52, at 228.

134. *See id.*

135. 42 U.S.C. § 4332(2)(A) (2000); CALDWELL, *supra* note 13, at 56-57; *see also* 40 C.F.R. § 1502.6 (2002) (requiring EIS preparation to use an interdisciplinary approach).

social science methods might mitigate some of the uncertainty of classical science in certain situations, NEPA's implementing regulations primarily focus on the scientific analyses of environmental impacts.[136] Classical science nonetheless serves a useful analytic purpose, so long as its limitations and biases are properly recognized and handled.[137]

From the scientific perspective, asserting or claiming a possible environmental impact is akin to adding to the body of collective scientific knowledge; showing connections and relationships between actions and results, or cause and effect relationships, augments the existing body of knowledge.[138] To maintain the most accurate and dependable body of knowledge, the scientific method naturally requires a high threshold of evidence before a researcher can claim a cause and effect relationship.[139] The generally accepted confidence level of 95% means that there must be only a one in twenty chance that a cause and effect relationship does not exist for a researcher to claim that the data support such a relationship.[140] Conversely, conventional practice allows a larger margin of error for rejecting a cause and effect relationship when it in fact exists—up to a one in five chance, or four times as often as mistakenly accepting a non-existent cause and effect relationship.[141]

These two types of scientific error are called "type I" and "type II" errors.[142] Most scientists consistently hold type I error (the chance of claiming a cause and effect relationship when it in fact does not exist) down to 5%, and let type II error (the chance of rejecting a cause and effect relationship when it in fact does exist) fluctuate between 5% and 20%.[143] Type II error can fluctuate beyond 20%, however, thereby incurring an even greater risk of claiming that no adverse environmental impact

136. *See generally* 40 C.F.R. § 1502.1-.25 (concentrating primarily on how to use classical scientific evidence in an EIS, and devoting only one small paragraph to addressing interdisciplinary evidence).

137. *See* CALDWELL, *supra* note 13, at 57 (stating that science usefully tests underlying assumptions, but scientific conclusions become questionable when the underlying assumptions can be disproved or revealed as biased).

138. *See* Lemons et al., *supra* note 52, at 214-15.

139. *See id.* at 227; *see also* Brown & Zaepfel, *supra* note 39, at 384 (stating that regulation should not occur without a high level of scientific certainty).

140. *See* Lemons et al., *supra* note 52, at 224.

141. *See id.*

142. *Id.*

143. *Id.*

will occur when in fact it will.[144] Because environmental impacts often involve numerous and complex interactions, type II error increases and, using the classical 95% rule, "increases the likelihood that serious future consequences are overlooked."[145] Therefore, in the environmental sciences, the scientific process puts a higher burden of proof on those claiming that an adverse impact may occur. In other words, the scientific 95% rule for labeling causal relationships "certain" operates to discourage precautionary conclusions.[146] While this approach effectively serves the interests of science, it cuts against the precautionary policy of NEPA and conflicts with the traditional legal standard of 51%.[147]

C. COURTS SHOULD ENFORCE AGENCIES' RESPONSIBILITIES TO ADDRESS UNCERTAINTY

An increasingly pervasive and disturbing trend among some federal circuits is giving undue deference to agency methods and procedures of decision making during the EA and EIS process,[148] despite implementing regulations that contain rigorous discussion and disclosure requirements.[149] To enforce the precautionary purposes of NEPA, courts must, at a minimum, diligently enforce those regulations dictating how agencies must handle scientific information and lack thereof. Because the scientific method itself discourages precautionary conclusions,[150] courts should also adopt specialized procedures for the admission and handling of scientific evidence. In particular, this Note recommends classifying scientific evidence as "certain" if it satisfies traditional legal standards of proof, even when classical scientific standards of proof would label such evidence "inconclusive."[151]

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144. *See id.* at 225-27.

145. *Id.* at 217.

146. *See id.* at 217-18, 228.

147. *See id.* at 228; *supra* notes 52-54 and accompanying text (discussing the difference between scientific uncertainty and legal findings). *See generally* Brown & Zaepfel, *supra* note 39, at 379-87 (discussing scientific evidence in legal proceedings).

148. *See supra* notes 82-88 and accompanying text; *see also* Brown & Zaepfel, *supra* note 39, at 387 (discussing court deference to agency experience).

149. *See supra* notes 46-51 and accompanying text.

150. *See supra* notes 138-47 and accompanying text.

151. *See* Lemons et al., *supra* note 52, at 231-35 (suggesting a similar approach at the decision-making stage).

1. Courts Must Ensure that Agencies Correctly Label Evidence as "Uncertain" and Adequately Discuss Such Evidence

Courts must remain mindful of the scientific definition of "uncertainty"[152] and ensure that agencies do not mislabel otherwise valid information. Such mislabeling has the same effect as an attempt to evade information gathering by claiming that the analysis of future environmental effects would be "crystal ball inquiry."[153] Because the scientific threshold for establishing a causal relationship already rests at the 95% level of confidence, a very high level for a field as complex as environmental science, agencies must treat scientific evidence that meets this high burden seriously.[154] Only if the scientific conclusions themselves establish indirect or minimal causal relationships, or are lacking altogether, should a court allow an agency to conclude that significant impacts are "uncertain." The CEQ regulations imply that only incomplete or unobtainable information constitutes uncertain evidence because an agency may exclude only such information from its environmental impacts analysis.[155]

A particularly severe example of inappropriate deference to an agency's characterization of scientific evidence as "uncertain" is the Seventh Circuit's decision in *Sierra Club v. Marita*.[156] The *Marita* court deferred to the Forest Service's acknowledgement and dismissal of an entire field of science, conservation biology.[157] The court held that the Service took a "hard look" at evidence from the field of conservation biology,[158] even though the Service did not include the evidence within a significant impacts analysis.[159] Amici correctly pointed out that

152. *See supra* notes 52-54 and accompanying text.

153. *See* Alaska v. Andrus, 580 F.2d 465, 473 (D.C. Cir. 1978), *vacated in part on other grounds sub nom.* Western Oil & Gas Ass'n v. Alaska, 439 U.S. 933 (1978) (citing Scientists' Inst. for Pub. Info., Inc. v. Atomic Energy Comm'n, 481 F.2d 1079, 1092 (D.C. Cir. 1973)); *see also supra* notes 101-02 and accompanying text (discussing agency requirements).

154. *See supra* notes 52-58 and accompanying text (describing the conventional scientific level of confidence of 95% and the difficulty of obtaining such a level of certainty in the environmental sciences).

155. *See* 40 C.F.R. § 1502.22 (2002) (permitting the exclusion of relevant but incomplete or unobtainable information).

156. 46 F.3d 606, 623 (7th Cir. 1995).

157. *Id.*; *see supra* notes 86-88 and accompanying text.

158. *Marita*, 46 F.3d at 623-24.

159. *Id.* at 622-23.

merely because any scientific proposition is "inherently unverifiable and at most falsifiable" does not mean that the Service can simply choose which propositions to analyze, writing off the rest as "uncertain."[160] Amici argued that an agency could thereby ignore the theory of gravity if it so wished.[161] Nonetheless, the court credited the Service's justification for ignoring such evidence—that conflicting scientific evidence existed regarding the need to provide large areas of old growth habitat.[162] Conflicting evidence, however, does not qualify as "uncertain" unless it fails to meet the 95% level of certainty[163] and does not excuse an agency from studying scientifically valid theories that suggest that a significant impact may occur.[164] As *Marita* demonstrates, courts should ensure that an agency correctly characterizes "uncertainty" before deferring to that agency's failure to fully analyze scientific evidence.

The regulations promulgated by the CEQ under its NEPA authority already substantially uphold the precautionary purposes of NEPA. The CEQ intended its implementing regulations to prescribe procedures that would foster good decision making.[165] Because courts cannot review an agency's ultimate decision whether or not to proceed with a proposal,[166] fully enforcing the underlying procedural mandates is vital to giving NEPA any of its intended effect.[167] Some courts have ignored the CEQ requirements of acknowledging and discussing uncertain information. In *National Parks & Conservation Ass'n v. United States Department of Transportation*,[168] the Ninth Circuit held that the EIS prepared by the FAA adequately discussed the potential impacts of alien

160. *Id.* at 622.

161. *Id.*

162. *Id.* at 623.

163. *See supra* note 52 and accompanying text (defining "scientific uncertainty" as less than a 95% level of certainty).

164. *See* 40 C.F.R. § 1502.22(a) (2002) (requiring the agency to acquire information "essential to a reasoned choice among alternatives" if costs of obtaining the information "are not exorbitant").

165. *See id.* § 1500.1(c) (stating that "NEPA's purpose is to . . . foster excellent action"); *see also supra* notes 83-84 and accompanying text.

166. *See* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) ("NEPA itself does not mandate particular results, but simply prescribes the necessary process.").

167. *See id.* at 350 (stating that "[t]he sweeping policy goals announced in § 101 of NEPA are thus realized through a set of 'action-forcing' procedures").

168. 222 F.3d 677 (9th Cir. 2000).

species introduction from the expansion of an airport and did not arbitrarily or capriciously conclude that the threat of introduction was insignificant.[169] The court found that the notorious unreliability of airport demand projections, "purely speculative" environmental damage, and failure of the plaintiffs to identify a particular species that would be introduced constituted high scientific uncertainty.[170] The court further found that the detailed mitigation plan within the EIS adequately addressed the potential impacts.[171] As the dissent noted, however, the FAA discussion of the threat of introduction was "virtually non-existent."[172] At the very least, the FAA should have included a detailed statement within the EIS addressing the incomplete or unobtainable information relating to foreign species introduction, as required by NEPA's implementing regulations.[173]

2. Courts Should Translate the Scientific Standard Governing Causal Relationships to a Legal Standard to Uphold NEPA's Precautionary Nature

Some commentators argue that the precautionary principle cannot effectively serve as a standard of review due to its vagueness.[174] One need not agree on an across-the-board definition of the principle to promote effective procedures, however, but rather need only promote greater precaution or less anti-precaution to serve the particular goal at issue.[175] For example, many commentators suggest implementing the precautionary principle by shifting the burden of proof to proponents of potentially harmful activities, requiring them to show that the activities will not cause harm.[176] While such a

169. *Id.* at 682.

170. *Id.* at 680-81.

171. *See id.* at 681 (concluding that "mitigation measures included in the EIS are sufficient to satisfy NEPA").

172. *Id.* at 687 (Fletcher, J., dissenting).

173. 40 C.F.R. § 1502.22(b) (2002).

174. Bodansky, *supra* note 11, at 5 (noting that "the precautionary principle . . . is too vague to serve as a regulatory standard"); *see also* Lemons et al., *supra* note 52, at 210 (asserting that no definition of the precautionary principle is "concrete enough" to allow for implementation).

175. *See generally* Elizabeth Fisher, *Is the Precautionary Principle Justiciable?*, 13 J. ENVTL. L. 315, 321-34 (2001) (describing effective judicial applications of the precautionary principle).

176. Bodansky, *supra* note 11, at 5 (acknowledging the existence of versions of the precautionary principle that "go to the opposite extreme by reversing the burden of proof"); *see, e.g.*, Lemons et al., *supra* note 52, at 230

remedy might eliminate risk to the public health, such a large burden on a proponent of any major federal action subject to NEPA would likely halt all or most development and receive significant criticism.[177] On the other hand, a number of characteristics of challenges under NEPA suggest that lowering the scientific standard of 95%, rather than actually shifting the burden of proof, would better serve the precautionary approach. First, courts are already required to determine whether an agency took a "hard look" at scientific evidence in challenges under NEPA.[178] Second, the contested scientific conclusions often if not always determine whether the agency concludes that a significant environmental impact will occur.[179] NEPA mandates such reliance by requiring that agencies rely on scientific evidence by utilizing "a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences" when planning and making decisions that may have an impact on the environment.[180] Finally, courts are increasingly able to deal with and understand scientific evidence due to the increasing use of science in the courtroom.[181]

While members of the scientific community might balk at such a suggestion if they view it as a threat to the scientific method itself, courts should treat relevant scientific evidence that shows a likely adverse impact at 51% or higher as warranting consideration in an environmental review

(listing reasons in favor of reversing the burden of proof); Raffensperger, *supra* note 66, at 10 (stating that the burden should be reversed, and placed on "those who have the power, control, and resources to act and to prevent harm").

177. *See* VANDERZWAAG, *supra* note 61, at 14 (stating that to demand a showing of absolute harmlessness "would be asking the scientifically impossible"); Christopher D. Stone, *Is There a Precautionary Principle?*, 31 ENVTL. L. REP. 10790, 10791 (2001) (observing that applying the "extreme" prospect of reversing the burden of proof to the past would have prevented the existence of important technology like electricity); Bodansky, *supra* note 11, at 5 (asserting that viewing every activity with suspicion would be impractical).

178. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989); *see supra* note 89.

179. *See* LINDSTROM & SMITH, *supra* note 13, at 54-55 (suggesting that agencies use science to legitimize their ultimate conclusions); CALDWELL, *supra* note 13, at 58 ("In our society, a traditional role of science in relation to political policy has been to serve—not to question.").

180. 42 U.S.C. § 4332(2)(A) (2000).

181. Michael Freeman, *Law and Science: Science and Law*, *in* SCIENCE IN COURT 1 (Michael Freeman & Helen Reece eds., 1998) ("Law has always sought the assistance of scientists, though never more so than today.").

document.[182] In other words, evidence should not be limited to the much higher level of proof used in the scientific method (95%), but rather should conform to the traditional legal standard of preponderance of the evidence.[183] This will not conflict with the Supreme Court's *Daubert* standards, which govern the admission of scientific evidence in court and must focus "solely on principles and methodology, not on the conclusions that they generate."[184] Therefore, whether a study passes the *Daubert* test depends upon the experimental and data collection methods, and not the statistical level of confidence chosen.[185]

Although a level even lower than 51% might better serve precautionary goals, and any level below 95% could be justified as "more precautionary," a number of reasons justify setting the threshold at 51%. First, the legal community understands a 51% level of proof because it matches the common legal standard of "preponderance of the evidence." Second, unlike a lower threshold, a 51% level does not require different courtroom procedures because the burden of proof will remain with those alleging significant environmental impacts. Third, unlike a higher threshold, a 51% level attains the highest level of precaution without shifting the burden of proof. Fourth, a 51% level avoids most criticisms of applying the precautionary principle because it prescribes a precise level rather than vaguely calling for a shift in the burden of proof.[186] Finally, as a purely procedural modification, lowering the level of certainty to 51% does not require substantive review by the courts of agency decisions whether or not to proceed with activities that

182. Lemons et al., *supra* note 52, at 235 (emphasizing that "whether scientists involved in public policy-oriented research should be committed to the 95 percent rule is a normative or policy question, not a scientific one").

183. *See* Lemons et al., *supra* note 52, at 229-30 ("There is no overriding or prima facie reason for using the 95 percent rule.").

184. Daubert v. Merrell Dow Pharm., 509 U.S. 579, 595 (1993). The *Daubert* test consists of a four pronged analysis to determine whether evidence is relevant and reliable: (1) the scientific methods must be testable and capable of being shown to be false; (2) publication and peer review of the scientific methods strengthens admissibility; (3) the methods have a known and low error rate; and (4) the methods are generally accepted within the scientific community. *Id.* at 593-94.

185. *But see* Lemons et al., *supra* note 52, at 229 (arguing that the *Daubert* analysis effectively excludes "evidence that establishes a reasonable basis for concern about harm but does not conclusively establish causation").

186. *See, e.g.*, Bodansky, *supra* note 11, at 5 (criticizing the precautionary principle as being "too vague to serve as a regulatory standard").

may have an adverse impact on the environment.[187]

Using a lower level of certainty in the courtroom need not affect the traditional scientific method outside the courtroom, but rather will only require agencies to seriously acknowledge a greater number of potential environmental impacts. A different standard would not require any additional mathematical calculations because the same statistical test yields a numerical value that can be compared to a 95% level of confidence, a 51% level, or any level chosen.[188] The lower standard would require agencies to consider and analyze impacts that are otherwise less certain under stricter scientific conventions, thereby better serving NEPA's precautionary goals. In particular, while NEPA requires analyses for the purpose of speculation, the 95% rule operates to prevent speculation;[189] lowering the threshold will enhance the speculative process, thereby allowing courts to uphold NEPA's protective intentions. Not only will the lower standard of 51% coexist smoothly with present legal procedures, but it will also enable more effective enforcement and implementation of NEPA's precautionary elements.[190]

Application of a 51% rule to the evidence at issue in the Ninth Circuit case, *National Parks & Conservation Ass'n v. United States Department of Transportation*,[191] might have rendered the threat of introduced species a likely significant impact of the proposed airport expansion.[192] More specifically, if the likelihood of importing foreign species that would significantly effect the environment rested between 51% and 95%, then applying the 51% rule in lieu of the conventional

187. *See infra* Part II.D.

188. *See* DAVID S. MOORE & GEORGE P. MCCABE, INTRODUCTION TO THE PRACTICE OF STATISTICS 452 (2d ed. 1993) (discussing the P-value, a statistical value which can be measured to determine the strength of evidence for a given outcome).

189. Brown & Zaepfel, *supra* note 39, at 379 (explaining how the 95% confidence rule "implements the social norm that science should not draw false conclusions or speculate").

190. *See* Lemons et al., *supra* note 52, at 229 ("[L]egal rules on the use of scientific evidence in court proceedings may determine when laws that might be used to protect human and ecosystemic health may be enforced or implemented.").

191. 222 F.3d 677 (9th Cir. 2000).

192. *See id.* at 685 (Fletcher, J., dissenting) (noting that the proposed project would "produce an increase in the yearly non-stop arrivals from Asia from 0 to 1,100," and that such flights increase the risk of introducing Asian species).

95% rule would reclassify such evidence as a "likely environmental impact."[193] In that scenario, the court would have to remand and require the FAA to take a "hard look" at such evidence.[194] By requiring a more searching investigation of potential impacts, such a result in *National Parks* would have furthered the informed decision-making and action-forcing processes of NEPA.[195]

The implementation of the above recommendations—vigilant enforcement of NEPA's implementing regulations and a lowering of the scientific standard for determining whether an agency must consider scientific evidence—will result in a broader investigation of possible impacts. In particular, enforcing the regulations will lead to greater attention to cause and effect relationships that are possible but do not meet the conventionally strict level of proof in the scientific community. Furthermore, enforcement will ensure that agencies correctly label evidence as "uncertain." The resulting emphasis on possible adverse environmental impacts is exactly what NEPA intended.[196]

D. A PRECAUTIONARY APPROACH EMBODIES PROCEDURAL REVIEW

Whether Congress intended NEPA to require substantive results has been hotly debated since its passage in 1970.[197] Early judicial opinions, particularly the D.C. Circuit decision in *Calvert Cliffs Coordinating Committee v. United States Atomic Energy Commission*,[198] arguably opened the door to a substantive review component of NEPA.[199] The Supreme Court

193. *See* 42 U.S.C. § 4332(2)(C) (2000).

194. *Compare* 222 F.3d at 683 (Fletcher, J., dissenting) (arguing that the FAA should take a "hard look"), *with id.* at 682 (majority opinion responding that the data are too speculative to require such an investigation).

195. *See* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (holding that the action-forcing mechanisms that require agencies to take a hard look at potential environmental impacts uphold the broad policy goals of NEPA).

196. *See supra* Part II.A (explaining how NEPA's policies, goals, and requirements embody a precautionary approach towards projects with possibly adverse environmental impacts).

197. *See, e.g.*, LINDSTROM & SMITH, *supra* note 13, at 10 (stating that by not enforcing the substantive values of NEPA, courts seriously undermine congressional intent).

198. 449 F.2d 1109 (D.C. Cir. 1971).

199. *Id.* at 1115 (holding that "[t]he reviewing courts probably cannot reverse a substantive decision on its merits, under Section 101, unless it be

has repeatedly held since then, however, that NEPA confers only procedural rights, and courts may not review the decision of an agency to go forward with a project if the agency has complied with all procedural requirements of NEPA.[200] While the issue of substantive review under NEPA remains an interesting topic,[201] it does not affect the subject of this Note; reviewing scientific uncertainty as recommended in Part II.C will involve only procedural review.[202] Therefore, courts should not decline to review decisions regarding scientific uncertainty solely on the grounds that any such review would involve substantive issues.[203]

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shown that the actual balance of costs and benefits that was struck was arbitrary or clearly gave insufficient weight to environmental values."). *Compare* THOMAS R. LUNDQUIST, SUBSTANTIVE AND PROCEDURAL IN THE NEPA CONTEXT: SUGGESTED DEFINITIONS AND SOME FURTHER THOUGHT 14 (1975) (observing that most circuit courts agree that NEPA creates substantive rights), *with* LINDSTROM & SMITH, *supra* note 13, at 116-17 (explaining how federal courts had consistently upheld all of NEPA's policies, substantive and procedural, before the Supreme Court limited judicial review to only procedural compliance), *and* PERCIVAL ET AL., *supra* note 24, at 850 (suggesting that the Supreme Court in *Strycker's Bay Neighborhood Council, Inc. v. Karlen*, 444 U.S. 223, 227-28 (1980) (per curiam), rejected the D.C. Circuit's holding on substantive review in *Calvert Cliffs*).

200. "[I]t is now well settled that NEPA itself does not mandate particular results, but simply prescribes the necessary process." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) (citing Strycker's Bay Neighborhood Council, Inc. v. Karlen, 444 U.S. 223, 227-28 (1980) (per curiam), and Vermont Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc., 435 U.S. 519, 558 (1978)); *see supra* note 83 and accompanying text (observing that NEPA "does not mandate particular results, but simply prescribes the necessary process").

201. *See, e.g.*, LINDSTROM & SMITH, *supra* note 13, at 113-20 (describing the judicial history of substantive review under NEPA and arguing that recent Supreme Court decisions have mistakenly allowed only procedural review). NEPA's implementing regulations also emphasize that NEPA's purpose is to produce better environmental decisions, and not just better paperwork. 40 C.F.R. § 1500.1(c) (2002).

202. *See* Lynda M. Warren, *Using Law to Define Uncertain Science in Environmental Policy*, *in* SCIENCE IN COURT 183 (Michael Freeman & Helen Reece eds., 1998) (describing the treatment of scientific uncertainty in the courtroom and asserting that "[a]dopting the precautionary principle is not a scientific approach but a procedural change"); *see also* Fisher, *supra* note 175, at 328 (explaining that problems of judicial competence in applying the precautionary principle have been overcome "where the principle has been construed as a principle of procedural fairness").

203. *See supra* notes 83-88 and accompanying text (discussing the circuit court viewpoints on the precautionary approach and deference to agency interpretations); *see also* Brown & Zaepfel, *supra* note 39, at 387 (stating that otherwise courts defer to agencies based on grounds of expertise, rather than on a recognition that agencies have given appropriate weight or attention to

The first recommendation of this Note—fully enforcing the CEQ regulations—remains entirely within the realm of procedural review because the regulations state that they implement procedural requirements[204] and do not require a particular outcome or decision based upon the discussion of lacking information,[205] and federal courts have enforced the regulations without noting issues of substantive review.[206] The second recommendation of this Note—lowering the standard of admitting scientific evidence to 51%—also does not involve substantive issues because courts still will refrain from reviewing the agency's ultimate decision. The only difference in the courtroom will be that the court may have more evidence of cause and effect relationships against which to gauge whether the agency fully analyzed those relationships.

CONCLUSION

The dominant judicial trend of deferring to an agency's treatment of scientific uncertainty threatens the important goals Congress codified in NEPA. In particular, ignoring the unproven yet potential negative environmental impacts of a proposed agency action undermines the precautionary nature of NEPA, as evidenced by its requirements of public participation, consideration of alternatives, full discussion and disclosure of scientific analyses, and stated policies and goals. As the most demanding and broad piece of federal environmental legislation, NEPA should be carefully and fully enforced to best ensure a healthy environment for future generations.

The precautionary treatment of scientific uncertainty can be upheld in two ways. First, courts should diligently enforce NEPA's implementing regulations that require identification and discussion of incomplete and unavailable information. If

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uncertain scientific evidence).

204. *See* 40 C.F.R. § 1500.3 ("Parts 1500 through 1508 of this title provide regulations applicable to and binding on all Federal agencies for implementing the *procedural* provisions of the National Environmental Policy Act . . . ." (emphasis added)).

205. *See id.* § 1500.2 (outlining the overall responsibility of agencies and making only a general call to "restore and enhance the quality of the human environment" after all relevant policy considerations).

206. *See, e.g.*, Colo. Envtl. Coalition v. Dombeck, 185 F.3d 1162, 1172 (10th Cir. 1999) (finding adequate the EIS submitted by the Forest Service regarding a proposed expansion of a ski area within a natural forest); Sierra Club v. Marita, 46 F.3d 606, 623-24 (7th Cir. 1995) (finding that the Forest Service properly followed NEPA procedural requirements).

agencies meet this duty of disclosure, the public participation, alternatives, and overall analysis procedures will have more meaning and context. Moreover, if courts ensure that agencies correctly label evidence as "uncertain," then the analysis procedures will properly address all likely environmental impacts. NEPA's goal of informed decision making will thereby be enhanced. Second, the high scientific proof of causation requirement of 95% should be brought down to the traditional legal standard of causation by a preponderance of the evidence, or 51%, for purposes of requiring full analysis of impacts in an EIS. This adjustment will not only harmonize scientific and legal standards for establishing causation, but will also mitigate the inherent reluctance of scientists to acknowledge cause and effect relationships. A natural bias of the scientific method against acknowledging possible negative impacts will thereby be removed.

If the 51% rule advocated in this Note proves effective, it may also prove useful in application to other environmental statutes that promote precaution. This different scientific norm will uphold NEPA's precautionary and predictive requirements, effectuate NEPA's broad application to important environmental protection, and justify a heightened disclosure of scientific evidence. With the 51% rule and the diligent enforcement of NEPA's implementing regulations, courts can more meaningfully and accurately review agency decisions pursuant to NEPA, and our vital human environment will be better preserved.